Secondary effluent treatment by slow sand filters: Performance and risk analysis

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Abstract: The objective of this study is to examine the reuse of wastewater for beneficial purposes. To accomplish this objective, the efficiency of slow sand filters in removing total coliforms (TC) was studied using a probabilistic method. Three pilot scale slow sand filters were constructed at Alkhobar wastewater treatment plant, Dhahran, Saudi Arabia. The removal efficiency of filters was estimated under different operating control parameters, which included filtration rate (q), sand bed depth (d) and sand grain size (c). The Type III extreme value distribution best fitted the removal efficiency data. A multiple linear regression analysis was performed to develop a relationship for mean removal efficiency as a function of control parameters. The predicted mean response and experimental results of previous studies were compared to validate the empirical regression model. The control parameters and influent concentrations of total coliform were used in Monte Carlo (MC) simulations for calculating the reliability index (β). The reliability index and corresponding risk were calculated for lognormally distributed safety margins (SM). An effluent standard of 100 total coliform/100 mL was defined as capacity of the filter to ascertain the risks of exceedence, which was approximately less than 50 for 95% of the time. Pre and/or post disinfection would be necessary to meet the stipulated effluent standards for unrestricted agriculture use.